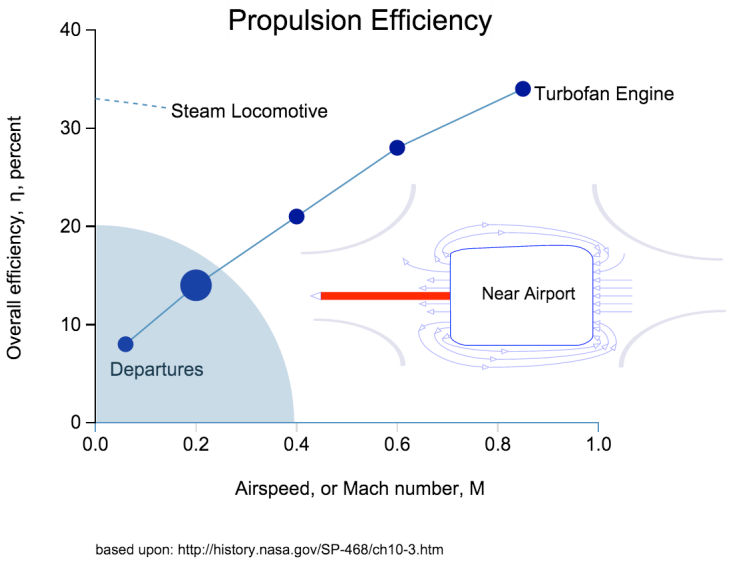
Electrifying Takeoffs: Clear the Congestion and Let Them Fly

Electrifying takeoffs overcomes the most basic tradeoff facing aviation that we call the Dr. Jekyll and Mr. Hyde effect. Turbo-fan engines perform very well at cruise speeds but poorly near cities.

Passenger aircraft engines operate in fundamentally different ways near airports than at cruise speeds due to different airflow through their engines. At cruise, modern turbo-fan engines outperform steam engines. Yet, at slower airspeeds, like around airports, their propulsion performance quickly tapers off to a fraction of that from steam trains. See the figure below. Near cities - blue tinted region - they burn excessive amounts of jet fuel but gain little propulsion; most of the chemical energy escapes as unused heat and noise. For New York City, the problem is compounded by the more than 1500 slow takeoffs each day that needlessly expose a large population to excessive congestion delays, noise and pollution - with constant demand for more flights.



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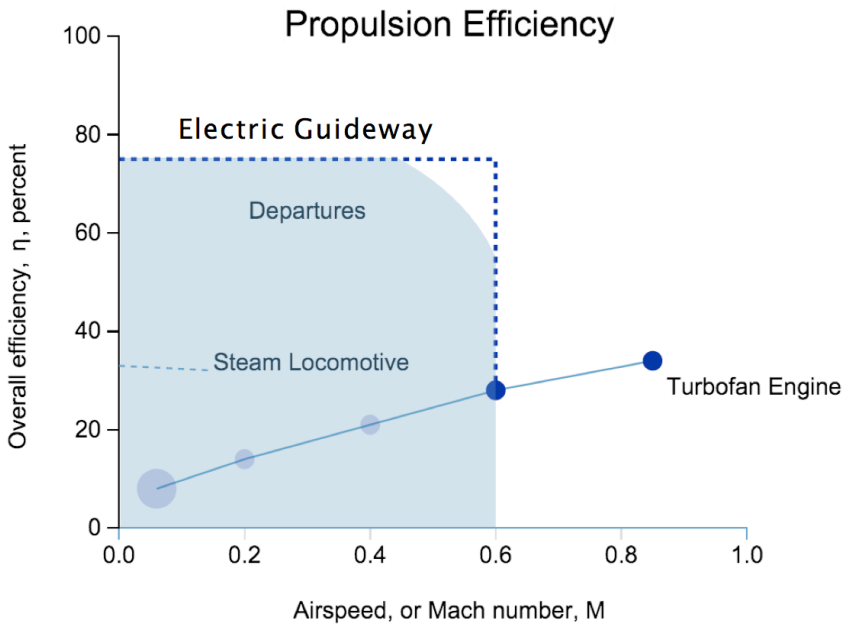
This tradeoff is not due to jet fuel limitations, or combustion per se, but due to the very difficult task of designing an engine that performs well over all airspeeds. At slow airspeeds, much larger fans or propellers would be needed. But, the drag from the same devices limits the top speed of aircraft far below the cruise velocities of today's jet aircraft.

Why not wait for electric aircraft? The limiting factor is the different fan size needed during takeoff vs. cruise, not what power source turns the fan. The need for ground-propulsion is even more pronounced for electric aircraft, because they lack the jet exhaust to fall back upon for thrust during slow airspeeds, as energy inefficient as it is. Electric motors in wheels are impractical for takeoff acceleration due to the mass of the

motors, the power distribution required from onboard generators, and takeoff velocity rotational limits of tires.

We need ground-powered takeoff to shift the lower performing portion of the graph to meet current state of the art for industrial technology, as seen in the figure below. To increase flight throughput and prevent congestion, aircraft must accelerate faster and takeoff at higher velocities. This is the only way aircraft can takeoff at higher rates; since their wakes are much smaller at higher velocities. Exhaustless provides electric takeoff propulsion for commercial aviation to increase flight operations capacity, while reducing fuel burn and noise near airports. Building upon military designs reduces the development effort.



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